Morrison, T.H., Adger, W.N., Brown, K. *et al.* (2020) Political dynamics and governance of World Heritage ecosystems. *Nature Sustainability* 3, https://doi.org/10.1038/s41893-020-0568-8

Political dynamics and governance of World Heritage ecosystems

TH Morrison[1], WN Adger[2], K Brown[2], M Hettiarachchi[3], C Huchery[1], MC Lemos[4], TP Hughes[1]

[1] ARC Centre of Excellence for Coral Reef Studies, James Cook University, Australia.
[2] College of Life and Environmental Sciences, University of Exeter, UK.
[3] Environment and Disaster Management Program, World Wildlife Fund, USA
[4] School of Environment and Sustainability, University of Michigan, USA.

Political dynamics limit the effectiveness of many environmental governance regimes, including the UNESCO World Heritage regime. We provide new evidence on how multiscale political dynamics mediate ecosystem interventions to produce a range of outcomes. We use the World Heritage In Danger system as a model system through which to explore the evolution of UNESCO interventions, counterproductive national responses to interventions, and ways of arresting counterproductive responses. Our findings inform how we can better anticipate and account for political dynamics in designing, implementing, and evaluating environmental governance.

Iconic ecosystems, such as the Galapagos Islands, the Three Parallel Rivers of Yunnan, and the Great Barrier Reef, are ecosystems of outstanding socio-economic, environmental and cultural value. Many of these high value ecosystems are protected or placed on 'in danger' lists to ensure their current and future conservation and use. Because of the substantial investment that international protection requires, it is reasonable to expect more effective conservation of those ecosystems than other ecosystems. Yet complex threats are causing many of these iconic ecosystems to diminish, in both function and extent [1-4]. Take the case of the Great Barrier Reef, for example, an ecosystem that successive Australian governments continue to shield from World Heritage In Danger listing by UNESCO, despite the system's highly threatened state[5].

Here, we report the findings of a global longitudinal study of the UNESCO World Heritage In Danger system [6-8]. We show the underestimation of threatened ecosystems, and document how hidden political dynamics cause some governments to preference rhetorical adoption, passive resistance or appropriation over compliance or negotiation with UNESCO. In studying these relationships, our primary purpose is to explain hidden political dynamics, and to use this systematic understanding to identify a broader set of solutions for enhancing sustainability governance. To our knowledge, this is the first attempt to assess how the World Heritage (WH) system is addressing ecosystem governance threats across multiple scales and time.

Governance threats are the threats to World Heritage sites that stem from multiscale political dynamics (such as industrial lobbying) and generate counterproductive site protection. There is widespread agreement that lobbying and 'politicization' limit the effectiveness of environmental governance regimes, including the World Heritage (WH) system [7-11]. At the local scale, expertise in managing such political dynamics has risen sharply over the last few decades [12]. We now understand how disputes about natural resource extraction can be resolved, for example, through deliberation, local rules and incentives [13-15]. Informational strategies such as environmental reporting and eco-certification can also assist in depoliticizing local ecosystem conflict [16,17]. Yet the strategic politics of iconic ecosystem governance at higher scales is barely understood. Indeed, UNESCO's own management-focused threat reporting tends to either overlook governance threats altogether or smooth them away according to broad stereotypes about poor governance in developing economies. More research is needed to determine exactly what governance threats are, how political dynamics mediate government responses to international intervention in iconic ecosystems, and further what to do about it [18,19].

International relations theory suggests, for example, that governments often avoid strategies of negotiation and compliance with international directives, in favor of alternative strategies such as manipulation and resistance[20,21]. Such strategies can reflect a conflict in priorities between a principal (an international organisation) and an agent (a national government) (this is known as the principal-agent problem) [22]. Socio-ecological systems theory suggests that political and socioecological dynamics can interact to produce atypical responses, surprise, and uncontrollability [23,24]. Such outcomes are problematic because they can tip an ecosystem into a new political and ecological state from which it is very difficult to return (this is known as

'hysteresis') [25]. However, beyond local snapshot studies of individual ecosystems, these insights are yet to inform our understanding of ecosystem governance [26,27].

Addressing these gaps and improving governance requires empirical evidence of how political dynamics play out across ecosystems and at multiple scales and over time. We used the UNESCO system as a model system through which to explore the multiscale politics of iconic ecosystem governance. Our central goal was to understand how "in danger" designations (or lack thereof) shape and are shaped by longitudinal relations between national governments and UNESCO, and the implications for ecosystem governance and outcomes. In Danger listing is not a top-down and static process; rather it is a relational and fluid exercise, occurring over many years [28]. Formal deliberations occur at annual World Heritage meetings, based on information received from national governments, the International Union for the Conservation of Nature, UNESCO's own reactive monitoring missions and NGO petitions [29]. While we acknowledge heterogeneities and competing interests within and among such actors [30,31], we focused on the relationships between UNESCO and the 102 national governments ultimately responsible for implementing ecosystem protection under the WH Convention. We combined In Danger certification patterns, site threat records and UNESCO deliberation frequencies for 238 sites between 1972 and 2019 to develop a more advanced system of site certification than UNESCO's own system. We then undertook extensive quantitative and qualitative process-tracing through document analysis (n=3099) and country-level analysis (n=102) to understand how "in danger" designations (or lack thereof) shape longitudinal relations between national governments and UNESCO, and the implications for ecosystem governance. Confidential interviews (n=32) enabled verification of system-wide results and extraction of site-specific examples (see Methods and Supplementary Fig S1).

Inconsistent use of In Danger listings

Examination of the use of the WH In Danger List since its inception in 1983 reveals inconsistent use, including a 31.6% decline In Danger listings between 2001-2008 (Fig. 1). Interviewees attributed this period of decline to "increased politicization" of the process (e.g. Interview WH01, also WH07, WH10). In the subsequent period (2009-2017), In Danger listings returned to previous levels, coinciding with, and perhaps because of, increased oversight by the International Union for the Conservation of Nature (IUCN). Indeed, the IUCN

advanced its own World Heritage Outlook assessment in 2011 with the stated goals of improving the independence and transparency of WHC decisions [32,33].

By 2019, only 16 out of 238 sites were certified on the World Heritage In Danger list, with a total of 30 sites certified at least once in the 1972-2019 period. However, a key finding from our analysis is that there are 41 sites that have never been certified as In Danger but which have reported threats equal to or higher in intensity than those certified as In Danger (threat intensity >=23.2) (Fig. 2). This is a new status of site – which we classify as "Technically In Danger" – a status that is currently unrecognized by UNESCO. Of these 41 Technically in Danger sites, 27 have been proposed for an In Danger listing more than once by the World Heritage Committee (WHC), but have never made it onto the In Danger list. For many of these sites, document analysis confirms divergence between WHC Advisory Body recommendations and subsequent WHC decisions, and inconsistencies between the WHC and formal World Heritage Advisory Body classifications, such as IUCN classifications. Our identification of Technically in Danger sites also corresponds with a clear plateauing of net In Danger listings from 2000 onwards, which is in stark contrast to the steady growth of net inscription of new World Heritage sites and deliberations on threats to individual sites.

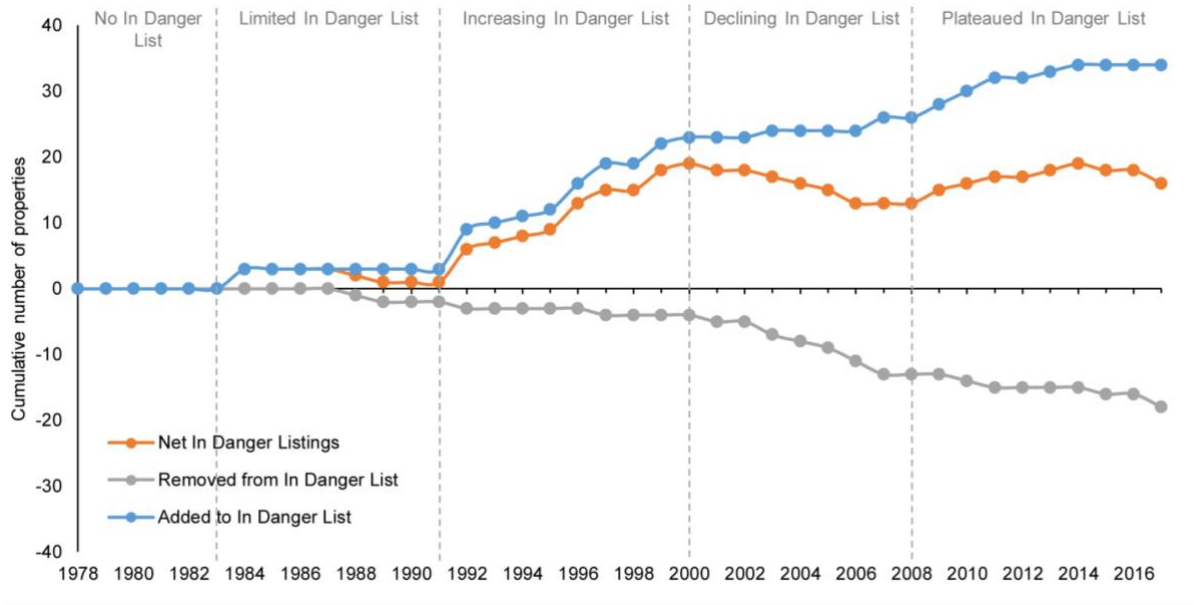


Fig. 1. Evolution of In Danger listings over time for natural World Heritage sites.

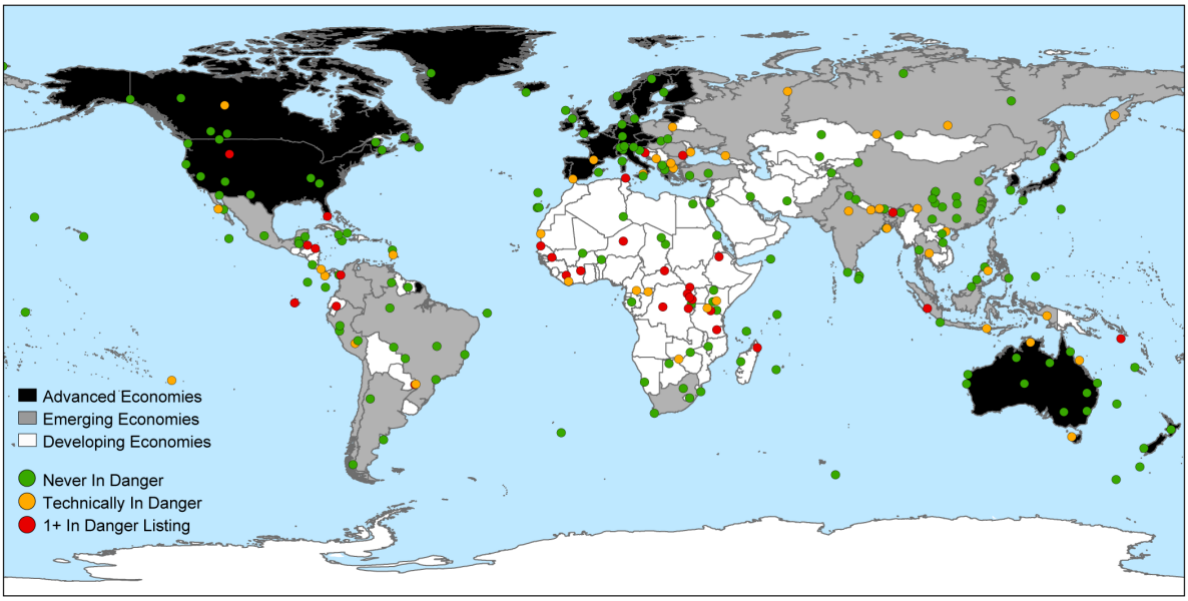


Fig. 2. Unrecognized extent of threats (in orange) for natural World Heritage sites.

Atypical responses to In Danger listings

How do we explain the persistence of Technically In Danger ecosystems over time? Why do sites that are just as threatened or more threatened than those certified as In Danger continue to evade the In Danger list? A key finding is that the threat of an 'In Danger' listing by UNESCO drives a range of responses by governments over time. While individual governments can and do change their responses over time, we found that analysing responses according to similar threat status, UNESCO intervention characteristics and national response characteristics enabled development of a generalised spectrum of responses (see Methods). At one end of the spectrum, we found sites that had either never been listed as In Danger, or had been listed at least once as In Danger, with government responses characterised by compliance, negotiation, or appropriation. At the other end, we found sites that were Technically in Danger, with government responses that can be best described as rhetorical and resistant to WH intervention (Fig. 3).

Compliance, for example, is associated with full acceptance of World Heritage values, with complying sites never certified as In Danger nor proposed for an In Danger listing, and governance characterized by transparent and regular reporting (56% of sites e.g. Ilulissat Icefjord, Denmark). **Negotiation** responses, by contrast, are associated with at least one In Danger listing and significant dialogue with UNESCO (17% of sites e.g. Galápagos Islands,

Ecuador; Tropical Rainforest Heritage of Sumatra, Indonesia; East Rennell, Solomon Islands; Manas Wildlife Sanctuary, India). **Appropriation**, on the other hand, occurs in the rare situation when the responsible government exploits an In Danger listing for its own internal purposes, such as to generate votes or wield power over local actors (1% of sites e.g. Everglades, USA; Yellowstone USA) (Fig. 3).

At the Technically in Danger end of the spectrum (26% of sites), most sites were characterised by rhetorical adoption responses. **Rhetorical adoption** occurs when governments exert their autonomy in an oppositional manner (through partial compliance and symbolic commitments) to repeated In Danger proposals and high threats (above certified In Danger levels) in order to keep a site off the In Danger list. Rhetorical adoption characterises 21% of all sites, including the Great Barrier Reef, Australia; the Three Parallel Rivers of Yunnan Protected Areas, China; and the Western Caucasus, Russia. Australia, for instance, avoided an In Danger listing for the Great Barrier Reef in 2015 by developing a long-term sustainability plan in 2016; however, the method of financing and implementing the plan was characteristic of rhetorical adoption rather than a clear display of compliance. For example, in 2018, an Australian national audit and Senate inquiry found that a significant portion of finance for the plan was delivered in a non-compliant (non-competitive and non-transparent) process to a private organisation with limited capacity and expertise, thereby jeopardising the ability to achieve the key actions and outcomes set out in the agreed plan [34-36] (Fig 3., Supplementary Table S1).

Passive resistance (5% of sites), by contrast, occurs when threats are high but the site attracts limited attention and effort from both the responsible government and UNESCO. Seven sites fall into this category, including geographically remote sites such as Tubbataha Reefs (Philippines) and Henderson Island (United Kingdom) as well as institutionally complex sites, including Banc d'Arguin (Mauritania), Mount Athos (Greece), Halong Bay (Vietnam), Komodo (Indonesia), and the Danube Delta (Romania) (Fig 3).

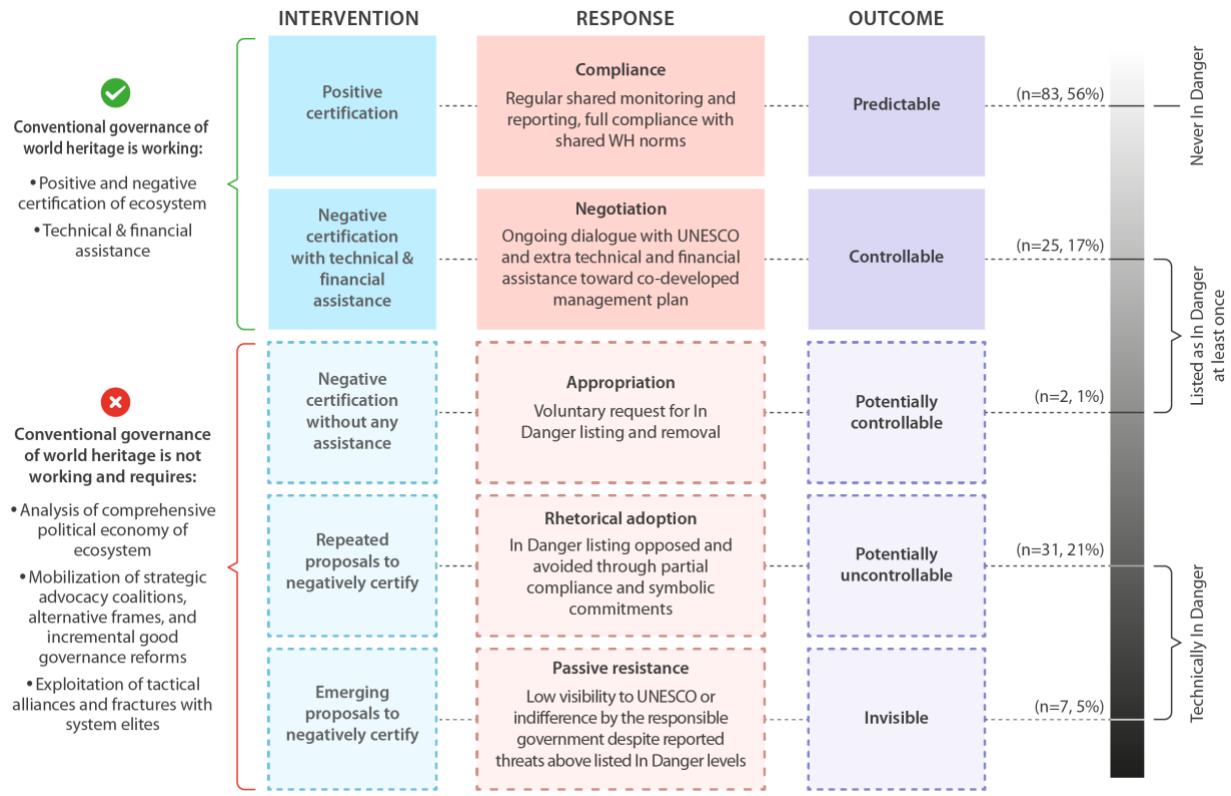


Fig. 3. | Governance of World Heritage listed ecosystems is a function of UNESCO intervention and national response. Most studies of World Heritage governance focus on interventions in proximate socio-environmental threats generating compliance and negotiation responses (top of diagram). A critical challenge in empirical approaches is to internalize how political threats mediate such interventions to generate alternate responses and less controllable governance outcomes (bottom of diagram).

Counterproductive governance outcomes

Do different responses to UNESCO intervention result in different environmental governance outcomes? Scientists and policymakers tend to hope that UNESCO interventions will result in either a predictable or a controllable ecosystem governance outcome. Here, however, we show that different types of responses generate different ecosystem governance outcomes, ranging from predictable at one end of the spectrum to uncontrollable and invisible at the other (Fig. 3).

Predictable relationships, for example, occur when an intervention (e.g. inscription of a location on the World Heritage list) results in the expected improvement in site governance (such as a compliance response characterised by positive certification and regular shared monitoring and reporting). The Danish government, for example, has consistently improved management of Greenland's Ilulissat Icefjord since inscription in 2004, including a 2018

management plan that explicitly acknowledges the effects of climate change on the glacier (Supplementary Table S1).

Likewise, controllable relationships occur when improved governance is dependent on periodic pulses of interventions (such as a negotiation response characterised by negative certification and/or technical and financial assistance). Many negotiating governments receive technical and financial assistance to assist them in moving towards compliance - this pathway is one of the stated intentions of the In Danger listing, and a strategic action by some governments. The Ecuador government, for example, has received repeated technical and financial assistance and an In Danger listing to assist in moving the Galápagos system toward compliance (Supplementary Table S1).

When site governance is immune to conventional interventions, such as certification and technical or financial assistance, the relationship is only potentially controllable. The USA government, for example, has alternately rejected or appropriated intervention in the Everglades[2] system in direct correlation with national political sentiment, resulting in a continuous cycle of multiple policy reversals. Under both the Clinton and Obama (Democrat) administrations, for example, the USA government requested that UNESCO certify the Everglades[2] as In Danger, in order to wield power over lower levels of government, other federal agencies, and private actors. Under the second Bush administration, by contrast, the USA government requested that UNESCO remove the site from the In Danger List, despite advisory board recommendations and stakeholder criticism (Supplementary Table S1).

When site governance is not only robust to conventional intervention strategies but also subject to rhetorical adoption, the relationship becomes even less controllable. The Australian Government, for example, has implemented symbolic and partially compliant policies to avoid an In Danger listing for the Great Barrier Reef [34,35,37], locking-in a new political and ecological state for the reef that concerned stakeholders have found difficult to penetrate (Supplementary Table S1).

Finally, invisible relationships occur when site governance is passive in the face of intervention, although we know little as to why. To understand the Ha Long Bay system, for example, additional research strategies would need to uncover drivers such as poverty levels,

World Bank intervention, proximity to China, and cultural resistance to intervention, amongst others[38] (Supplementary Table S1).

These different ecosystem governance outcomes are important because they have a material impact on the ground in WH sites. In the case of the Great Barrier Reef, for example, the lack of an In Danger listing has made it much easier for harmful developments on or adjacent to the Reef to be approved, and much easier for the Australian government to convince the public of the necessity to wind back national climate commitments[5]. As a consequence, the 2019 Great Barrier Reef Outlook Report assessed the overall outlook for the Reef as 'very poor,' and in 2020, the Great Barrier Reef bleached again for the third time in five years, generating grave concerns about the ecosystem's future ability to recover before yet another bleaching event.

High natural resource dependency drives rhetorical responses

Addressing counterproductive responses, such as appropriation, rhetoric and resistance, is a wicked governance challenge [39]. UNESCO's own reporting system does not explain this spectrum of responses. Indeed, UNESCO's reporting system only reports 'governance' threats when they relate to developing and emerging economies (Fig. 4).

Whether a nation's economy is developed, emerging or developing also does not solely explain this spectrum of responses. We must look to broader drivers, such as wealth, governance quality, economic complexity, and natural resource dependence, to uncover the reasons behind different responses (Fig 5). We use GDP as a proxy for wealth [40]. By governance quality, we refer to control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, and voice and accountability[41]. By economic complexity, we mean the diversified capability of a nation's economy[42]. By natural resource dependency, we refer to the dependency of a country's exports and services on primary resources (such as agriculture, forestry, mining and environmental tourism) [43-48].

As broad stereotyping of governance in developed vs. developing economies would suggest, WH sites characterized by compliance and appropriation responses are often located in advanced economies (45% for compliance, 100% for appropriation) with limited dependence on natural resources and high GDP, governance quality, and economic complexity. Sites

characterized by negotiation responses, by contrast, are primarily located in developing economies (84%) with lower values in all social and political indices, such as GDP per capita and governance quality. Negotiation responses also correlate with lower economic complexity and higher levels of dependence on natural resource industries (e.g. mining, forestry, and environmental tourism) (Fig. 5). These results reflect common stereotypes about the relative challenges of achieving ecosystem sustainability in developed vs. developing economies.

However, we also found results that challenge such stereotypes. WH sites characterized by rhetorical adoption responses, for example, include many in the advanced (23% e.g. Australia) and emerging (45% e.g. China, Russia) economies (Fig. 6). These economies exhibit high levels of GDP and natural resource dependence, but lower levels of economic complexity and governance relative to economies with compliance responses (Fig. 5). In these economies, high levels of GDP and natural resource dependence are mutually reinforcing, reflecting the sheer power of industrial-scale resource development over efforts to sustainably govern protected areas [1,2]. Put simply, when an economy is dependent on limited high-value natural resource industries, our analysis suggests that governments will preference rhetorical adoption over compliance or negotiation, irrespective of overall economic development level.

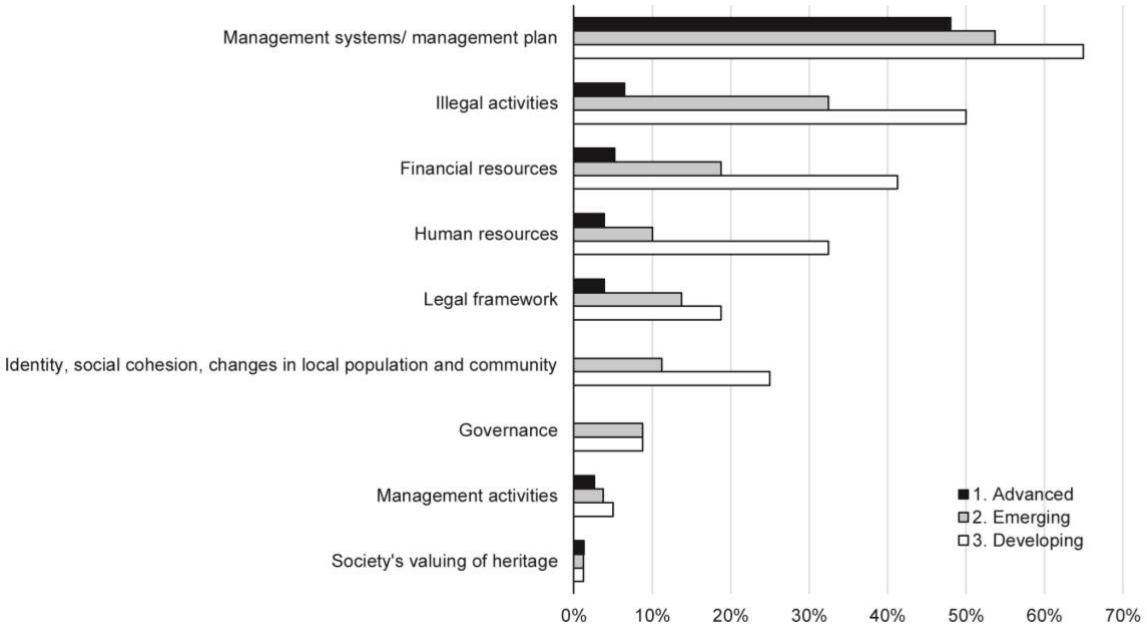


Fig. 4. Governance threats overlooked in UNESCO's own reporting. Only 6% of 238 natural WH sites have ever had 'governance' declared as a threat by UNESCO, with a strong bias toward developing economies (7 sites) and emerging economies (7 sites), rather than developed economies (0 sites). Most reporting is focused on local "management" threats rather than governance threats at other scales (World Heritage reporting across economy types for relevant social and institutional threats) [6].

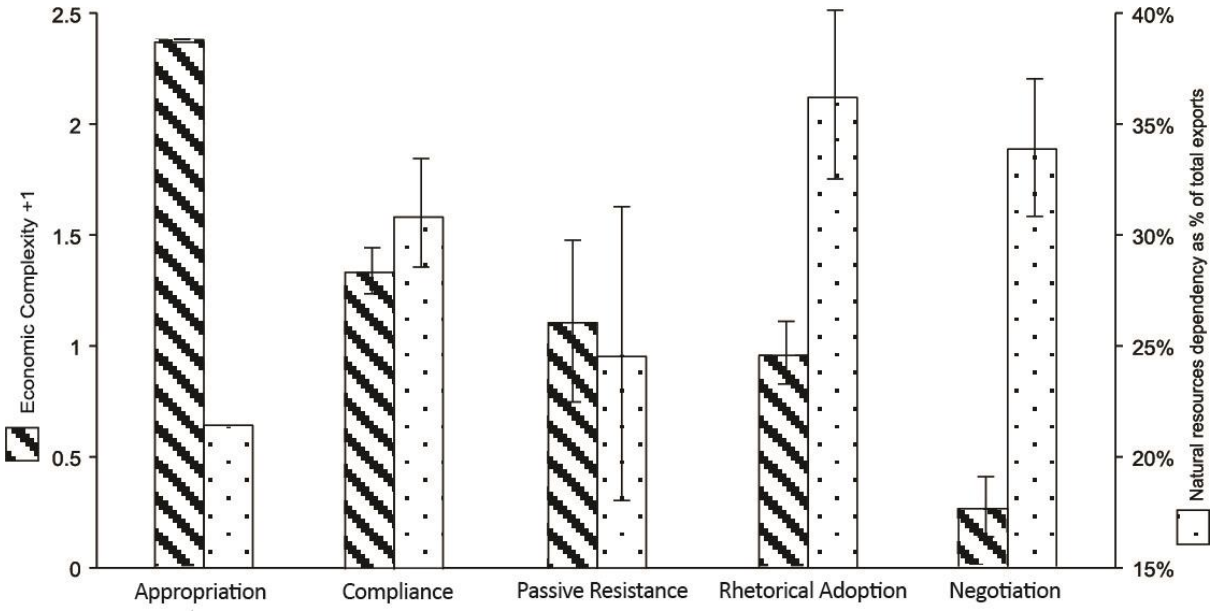


Fig. 5. National responses according to economic complexity and natural resource dependency. MIT economic complexity levels (left, average +/- standard error) and World Bank natural resources dependency (right, international tourism receipts, agricultural raw material exports, fuel exports and ores and metal exports, as a percentage of total exports) [43-49].

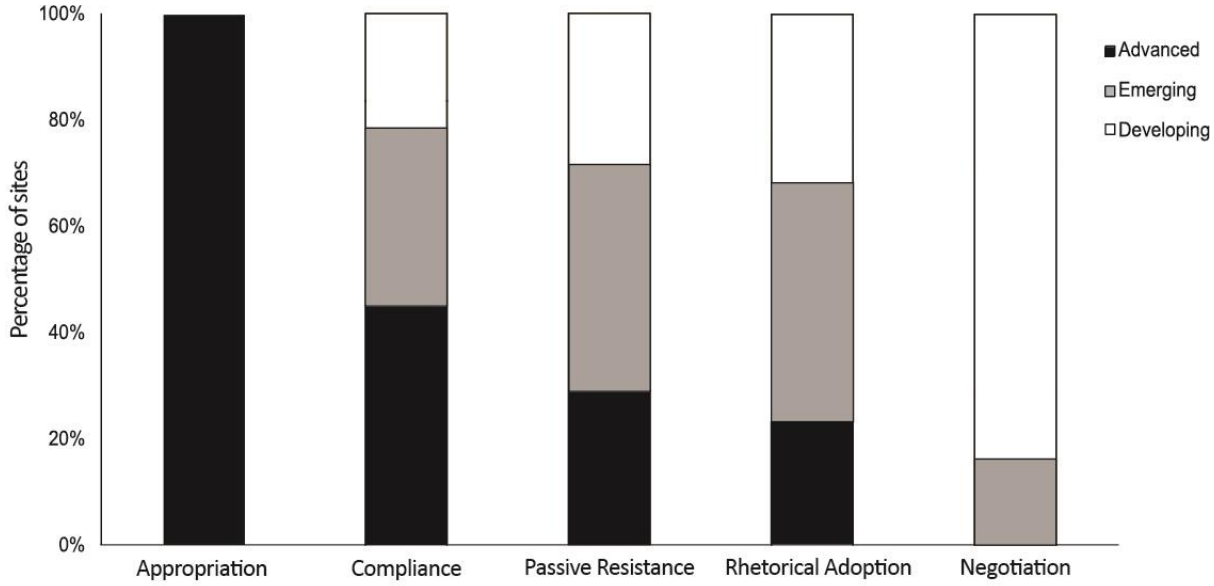


Fig. 6. National responses according to economy type. IMF economic development categories [50].

The problem of regulatory capture

Why does high natural resource dependency cause governments to favour rhetorical adoption over straightforward negotiation or compliance? In sites characterized by rhetorical adoption, we found that the influence of natural resource industries extends far beyond their local

environmental footprint. Interviewees confirmed that coalitions of industry actors, "some of whom are more powerful than individual nation-states," are capable of having a significant political impact on a government's stance on World Heritage, and have become a prime motivator in both seeking World Heritage status and keeping threatened sites off the In Danger list (Interviews WH01, WH07, WH10, WH14).

Industry coalitions often lobby governments, UNESCO and WHC member countries, claiming that an In Danger listing diminishes a nation's international reputation and restricts foreign investment, national productivity, local employment, and industrial license to operate. For example, powerful coalitions of industry actors have sought to challenge the World Heritage system and undermine reports by scientists, NGOs, and the media. These efforts have heightened a government's sense of political threat by linking In Danger listings to national economic performance and to the individual reputations of politicians and senior bureaucrats (Interview WH14).

Governments have responded to these pressures by prioritising management of reputational threat (e.g. through diplomatic pressure on WHC member countries and partial compliance) over environmental threat (e.g. Interview WH14). Because such responses reflect regulatory capture of governments by powerful industry interests [51,52], interviewees confirmed that politicians and bureaucrats often work to conceal these dynamics, rendering the governance outcome both unpredictable and uncontrollable. At the same time, UNESCO itself is acutely aware of these dynamics and concerned about threats to its own reputation (Interview WH01). In these circumstances, interviewees stated that the usefulness of the List of World Heritage in Danger as a policy tool is diminishing, because "the energy of the Convention and the responsible governments is spent in a way that does not improve the protection of WH areas" (Interview WH01).

Challenges for World Heritage

The World Heritage case shows that interventions that have proven effective in developing economies (such as local science-based improvements in management capacity and resources) are less adequate in advanced and emerging economies characterized by high natural resource dependence. In many instances, distal political threats such as reputational risk mediate how

governments respond to local socio-environmental threat. Indeed, managing political threats (such as reputational risk) now forms the pervasive logic of some governments, especially in the advanced and emerging economies. This phenomenon parallels a global trend whereby managing reputational threat is now the dominant concern of many large organisations [53]. In these cases, conventional interventions are failing to address the degradation of the world's iconic ecosystems. The WH system is locked in a governance trap, whereby the ability to arrest degradation is constrained by both a misdiagnosis of the nature of the problem and the unpredictable and uncertain behavior of the actors responsible for its solution [37].

Harnessing governance threats to improve environmental governance

While World Heritage is an important but very small part of the environmental estate, the evidence here is sufficient for scientists, NGOS and policymakers to develop an 'immune system' of countervailing power against industrial lobbying and regulatory capture in all environmental governance. Indeed, a number of emergent developments in the World Heritage system demonstrate that it is possible to "harness" such governance threats, that is, to use the power of governance threats to produce a new kind of power. For example, a nascent international network known as World Heritage Watch has mobilised to form a competing coalition and push for similar standing to the World Heritage Centre and the formal Advisory Bodies. New availability of GIS imagery and online reporting is beginning to usher in an era of greater transparency and accountability, revealing alternative compliance and conflicts of interest. PADDDtracker.org, for example, is an online, crowd-sourced mapping tool for measuring and disseminating data on protected areas that are being dismantled [54]. In 2019, the World Wide Fund for Nature released a report recommending a strategic reframing of the World Heritage Convention and tactical changes to its structures and processes. And, in February 2020, a consortium of 76 organizations and individuals petitioned UNESCO to address national climate action in World Heritage decision making.

However, long-held assumptions and knowledge gaps in environmental governance remain. Prevailing beliefs about poorer governance in developing economies, for example, must be rejected in the face of the powerful influence of industry elites in advanced and emerging economies. Additional research is required to understand how intervention strategies can be designed to target higher-level elites (such as politicians, senior bureaucrats, and business elites), rather than environmental ministries, local resource managers, scientists, and

environmental groups (who are often the least powerful within their own country, but the typical target of ecosystem interventions[55]).

In this regard, recent findings on international peacekeeping intervention in resistant states[21,56,57] could be usefully extended to efforts to improve environmental governance. It is possible, for instance, to redirect the national balance of power away from industry lobbyists through supporting broader good governance and compliance. Strategic reframing[37] can be used to highlight mutual interests to this broad polity, such as economic resilience and resource security. Reframing can also be used to exploit key fractures, such as internal corruption, and to focus blame, for example, by highlighting how resource dependency increases risk of economic and political capture at regional and national levels (Fig 3.). Further study of the role of transparency mechanisms, government audits, inquiries and commissions, independent certification, and deliberative experiments will also enable better identification of other forms of intervention[12,15,17].

Conclusion

Ecosystems are under threat. International science-based interventions, such as protected are designation and monitoring, are typically upheld as the solution. Our analysis illuminates the underestimation of the threats, and documents how the traditional powers of the nation-state and rational science continue to struggle to arrest those threats. In the case of World Heritage, hidden governance threats explain why some governments preference rhetorical adoption, passive resistance or appropriation over compliance or negotiation.

Against this backdrop, ongoing debates over better engagement of civil society, a Code of Conduct for State Parties, improved certification of individual sites and a mechanism for national climate accountability, are all setting the agenda for UNESCO World Heritage. These developments are still in their infancy, and many of them require a fundamental reorganization of the national and international political economy if they are to succeed. We do not fully understand the potentials and limitations of these developments as a means of improving the outlook for WH ecosystems. However, their unifying characteristic is that they provide important insight into how all environment actors can better apprehend and indeed harness political dynamics to produce a more productive form of governance.

As human pressures on the environment accelerate, it is critical to strengthen – not weaken – governance across the entire environmental estate. The Australian government's 2019 rhetoric on segregating climate change from World Heritage intervention could embolden other countries to embrace a similar race to the bottom. Given the global investment in environmental governance over the last fifty years, it is essential to accelerate research and support evidence-based strategies to address hidden governance threats and safeguard all ecosystems.

Methods

We investigated the assumption that the standard mix of World Heritage interventions (namely 'in danger' certification, financial assistance, co-developed management plans, and ongoing threat monitoring) will effectively arrest ecosystem degradation. We approached the problem of ecosystem intervention by focusing on how political-economic dynamics shape and are shaped by UNESCO intervention and national response across multiple scales and contexts.

Global Database of World Heritage. We compiled a database of 238 UNESCO World Heritage (WH) Areas certified for their natural or mixed (natural and cultural) significance across 102 nation-states and spanning the period 1972-2019 (Supplementary ref. 1-2). The interactions for those individual sites and the WH system as a whole were first studied by analysing quantitative patterns of threat reporting and In Danger certification, and then undertaking extensive process-tracing through document analysis, key informant interviews, and country-level analysis to understand specific governance responses. Based on the threat and In Danger analysis, we developed a global analysis of the unrecognised extent of World Heritage sites in danger. Documentary analysis, stratified key-informant interviews, and country-level correlation enabled development of a model of national responses to In Danger

listings. We then assessed different types of responses to reveal different types of outcomes. This process enabled the preliminary theory and typology of iconic ecosystem governance developed from the literature, to be expanded and verified (Supplementary Fig. S1). The study is a mixed-methods study combining in-depth interview data (qualitative) with global site threat data (quantitative), data from UNESCO and governmental records (qualitative and quantitative), and economic and governance data (quantitative). We combined new interview data with new analysis and combination of existing raw data (quantitative and qualitative) from UNESCO, individual governments, the World Bank, the IMF, and the MIT Economic Complexity Index. We achieved validity and reliability through multiple sources of evidence, inter-coder checks, process-tracing, and comparative analysis.

Ecosystem Threat and In Danger Analysis. Initial analysis was undertaken of the different types of threats reported and the frequency of different types of threats for individual sites (n=238) and across the whole WH system. Threats included both primary threats (n=14) and secondary threats (n=65). The Threat Intensity (TI) value is a quantitative measure of the frequency of UNESCO World Heritage Committee deliberations on threats to individual sites (Supplementary ref. 2). We averaged the TI to determine sites that UNESCO has never certified as In Danger, but which have a TI value equal or higher to the lowest TI value of the In Danger sites (Supplementary Fig S1). This revealed an additional 41 sites that have never been certified as In Danger but which have had an average TI value equal or higher to this threshold (TI>=23.2 since inscription, n=41). We termed this new category 'Technically in Danger' – an entirely new category we devised to distinguish those sites from sites that have either never been In Danger or have been both technically and formally In Danger at least once (which we termed 'Never in Danger' and 'In Danger') (Fig. 2). We also used the advanced word search function to interrogate the entire dataset to confirm that all other sites with a TI lower than this threshold could be categorized as Never In Danger. We then triangulated our results with changing patterns of threat reporting and In Danger listing over time, as discussed below (Fig. 1, Fig. 2).

Quantitative National Economic and Good Governance Correlation. We interrogated national economic and good governance variables because national governments are directly responsible for implementing ecosystem protection at the site level under the Convention. Quantitative country level data for the 238 sites (102 countries) was correlated with our new 3 categories of site (Never In Danger, In Danger, and Technically In Danger) (Supplementary

Fig. S2). IMF (International Monetary Fund) categories were used to class each national economy as advanced, emerging or developing (Supplementary Fig. S2) (Supplementary ref. 3). WorldBank data on GDP per capita (ppp current international $) and good governance (including (1) control of corruption, (2) government effectiveness, (3) political stability and absence of violence/terrorism, (4) regulatory quality, (5) rule of law, (6) voice and accountability) were correlated with the 3 new categories of site (Supplementary ref. 4-5) (Supplementary Fig. S2).

Quantitative and Qualitative Process Tracing. Process-tracing was undertaken through a content analysis of all Advisory Body Evaluations (n = 661), WH Decision Reports (n = 92), WH Mission Reports (n = 210), WH Periodic Reports (n = 533), WH State of Conservation Reports (n = 1,390), and State Party (Government) Conservation Reports (n = 213) pertaining to individual sites 1972-2019. Some of these documents required translation from French into English. The overall case spanned 238 sites; however, the focused analysis was restricted to the use of WH In Danger listing (potential/proposed/actual) for 148 sites inscribed on the World Heritage List for more than 10 years. We excluded 90 sites as they either spanned multiple countries (n=15), were too recently inscribed (since 2007) (n=52), or did not have sufficient reporting to be properly assessed (n=62) (Supplementary Fig. S1). We coded the remaining 148 sites according to five types of responses to a proposed or realised In Danger listing (Fig. 3, Supplementary Table S2). Sites that demonstrated regular shared monitoring and reporting and full compliance with shared WH norms were coded as “compliance”. Sites that demonstrated ongoing dialogue and extra technical and financial UNESCO assistance toward co-developed management plans were coded as “negotiation”. Sites that engaged in voluntary requests for In Danger listing and removal were coded as “appropriation”. Sites that opposed and avoided proposed In Danger listings through partial compliance and symbolic commitments were coded as “rhetorical adoption”. Sites that demonstrated low visibility to UNESCO or indifference by the responsible government despite reported threats above listed In Danger levels were coded as “passive resistance” (Fig. 3).

To supplement qualitative analysis of the nature of interactions between the World Heritage Committee and individual governments over time, we extracted quantitative and qualitative data on site-level and system-level use of In Danger listing (nonuse, proposed, enacted, or removed) and financial and technical assistance provided to individual sites over time. This data enabled process-tracing and validation of the changing usage of reporting, external

assistance, and In Danger listing 1972-2017 (Supplementary Fig. S1, Supplementary Table S1). To ensure inter-coder reliability, two coders also independently cross-checked a subsample of the data. See Supplementary Tables S1 and S2 for a detailed catalog of different types of national responses alongside a subsample of 5 representative cases.

Quantitative National Economic Complexity and Resource Dependency Correlation.
We interrogated national economic and resource dependency variables because national governments are directly responsible for implementing ecosystem protection at the site level under the Convention. Quantitative country level data for the 148 sites (70 countries) was correlated with the 5 categories of national response (Compliance, Negotiation, Appropriation, Rhetorical Adoption and Passive Resistance). Natural resources dependency was calculated as the sum of international tourism receipts, agricultural raw material exports, fuel exports and ores and metal exports, as a percentage of total exports (Fig. 5) (Supplementary ref. 6-11). We used the MIT Economic Complexity Index (ECI) (38) to understand the knowledge intensity of a country's economy and primary resource dependency of a country's exports (Fig. 5) (Supplementary ref. 12).

Stratified and Key-Informant Interviews and External Document Verification. Confidential interviews (n=32) were held with World Heritage experts from the World Heritage Committee, the Advisory Bodies, site management authorities, international and national ENGOs, national and provincial government agencies, international and national industry bodies, and research institutes. Because it was not possible to collect data from all key informants, we stratified the sample to ensure representation of most types of actors. 8 different strata were delineated, involving different combinations of WH actors experienced with environmental, political, or economic issues at regional, state, national, and international levels. 3 people were interviewed across each category. To triangulate further, in-depth interviews were held with 8 key-informants. Interviews occurred over a 12-mo period during 2018 and lasted 60–90 min each. We conducted interviews in person and by Skype. The interview questions were semi structured and focused on the governance of WH over time; how WH governance differs according to socio-environmental and political threats, and the variety of responses to an In Danger listing. Interviews were confidential in accordance with James Cook University ethics approval no. H6149. To check saturation and avoid recall bias, we compared the results against each other and against other sources of evidence, such as independent NGO data and individual government sources (Supplementary ref. 13-20).

Data availability

Findings are derived from the following primary and secondary data sources: in-depth, confidential stratified and key-informant interviews (n = 32 interviews), threat and certification data for natural World Heritage sites (n=238 sites), documentary analysis (n = 3099 documents); and economic and governance data (n = 102 countries) (Supplementary Fig. S1). The data that support the findings of this study (excluding confidential interviews) are available from the corresponding author upon request. Interview results are confidential in accordance with James Cook University ethics approval no. H6149. A detailed explanation of methods is available in Methods.

References

1 Kroner, R. E. G. *et al.* The uncertain future of protected lands and waters. *Science* **364**, 881-886, doi:10.1126/science.aau5525 (2019).

2 Qin, S. *et al.* Protected area downgrading, downsizing, and degazettement as a threat to iconic protected areas. *Conservation Biology* **33**, 1275-1285, doi:10.1111/cobi.13365 (2019).

3 Allan, J. R. *et al.* Recent increases in human pressure and forest loss threaten many Natural World Heritage Sites. *Biol Conserv* **206**, 47-55, doi:10.1016/j.biocon.2016.12.011 (2017).

4 Asner, G. P. & Tupayachi, R. Accelerated losses of protected forests from gold mining in the Peruvian Amazon. *Environ Res Lett* **12**, 094004, doi:10.1088/1748-9326/aa7dab (2017).

5 Morrison, T. H. Evolving polycentric governance of the Great Barrier Reef. *P Natl Acad Sci USA* **114**, 3013-3021, doi:10.1073/pnas.1620830114 (2017).

6 UNESCO. UNESCO World Heritage. (UNESCO World Heritage Centre, Paris, France) (2019).

7 Hølleland, H., Hamman, E. & Phelps, J. Naming, shaming and fire alarms: the compilation, development and use of the List of World Heritage in Danger. *Transnational Environmental Law* **8**, 35-57, doi:10.1017/S2047102518000225 (2019).

8 Brown, N. E., Liuzza, C. & Meskell, L. The politics of peril: UNESCO's List of World Heritage in Danger. *J Field Archaeol* **44**, 287-303, doi:10.1080/00934690.2019.1600929 (2019).

9 Bertacchini, E., Liuzza, C., Meskell, L. & Saccone, D. The politicization of UNESCO World Heritage decision making. *Public Choice* **167**, 95-129, doi:10.1007/s11127-016-0332-9 (2016).

10 de Wit, W., Machimbarrena, M., Tench, E. & Bigaud, N. Our Natural World at Risk: How politicization is limiting the effectiveness of the World Heritage Convention. (Dalberg Advisors for World Wide Fund for Nature, Gland, Switzerland, 2019).
11 Meskell, L., Liuzza, C., Bertacchini, E. & Saccone, D. Multilateralism and UNESCO World Heritage: decision-making, States Parties and political processes. *Int J Herit Stud* **21**, 423-440, doi:10.1080/13527258.2014.945614 (2015).
12 Agrawal, A., Hajjar, R., Liao, C., Rasmussen, L. V. & Watkins, C. Forest governance interventions for sustainability through information, incentives, and institutions. *Curr Opin Env Sust* **32**, A1-A7, doi:https://doi.org/10.1016/j.cosust.2018.08.002 (2018).
13 Bodin, O. Collaborative environmental governance: Achieving collective action in social-ecological systems. *Science* **357**, 659, doi:10.1126/science.aan1114 (2017).
14 Ostrom, E. A general framework for analyzing sustainability of social-ecological systems. *Science* **325**, 419-422, doi:10.1126/science.1172133 (2009).
15 Niemeyer, S. Deliberation in the wilderness: displacing symbolic politics. *Environ Polit* **13**, 347-372, doi:10.1080/0964401042000209612 (2004).
16 Lindenmayer, D., Thorn, S. & Noss, R. Countering resistance to protected-area extension. *Conservation Biology* **32**, 315-321, doi:10.1111/cobi.12990 (2018).
17 Lambin, E. F. *et al.* Effectiveness and synergies of policy instruments for land use governance in tropical regions. *Global Environmental Change* **28**, 129-140, doi:https://doi.org/10.1016/j.gloenvcha.2014.06.007 (2014).
18 Mastrángelo, M. E. *et al.* Key knowledge gaps to achieve global sustainability goals. *Nature Sustainability* **2**, 1115-1121, doi:10.1038/s41893-019-0412-1 (2019).
19 Young, O. R. Research strategies to assess the effectiveness of international environmental regimes. *Nature Sustainability* **1**, 461-465, doi:10.1038/s41893-018-0132-y (2018).
20 Dixon, J. M. Rhetorical adaptation and resistance to international norms. *Perspect Polit* **15**, 83-99, doi:10.1017/S153759271600414x (2017).
21 Zimmermann, L. Same same or different? Norm diffusion between resistance, compliance, and localization in post-conflict states. *International Studies Perspectives* **17**, 98-115, doi:10.1111/insp.12080 (2016).
22 Abbott, K. W., Genschel, P., Snidal, D. & Zangl, B. Competence versus control: The governor's dilemma. *Regulation & Governance* **n/a**, doi:10.1111/rego.12234 (2019).
23 Turner, M. G. *et al.* Climate change, ecosystems and abrupt change: science priorities. *Philosophical Transactions of the Royal Society B: Biological Sciences* **375**, 20190105, doi:doi:10.1098/rstb.2019.0105 (2020).
24 Kates, R. W. & Clark, W. C. Environmental surprise: Expecting the unexpected? *Environment* **38**, 6-34, doi:Doi 10.1080/00139157.1996.9933458 (1996).
25 Hughes, T. P. *et al.* Coral reefs in the Anthropocene. *Nature* **546**, 82-90, doi:10.1038/nature22901 (2017).
26 Sterner, T. *et al.* Policy design for the Anthropocene. *Nature Sustainability* **2**, 14-21, doi:10.1038/s41893-018-0194-x (2019).
27 Morrison, T. H. *et al.* The black box of power in polycentric environmental governance. *Global Environmental Change* **57**, 101934, doi:https://doi.org/10.1016/j.gloenvcha.2019.101934 (2019).
28 Cameron, C. & Rössler, M. *Many voices, one vision: The early years of the World Heritage Convention*. (Routledge, 2013).
29 Osipova, E. *et al.* IUCN World Heritage Outlook 2: A conservation assessment of all natural World Heritage sites. (IUCN, Gland, Switzerland, 2017).
30 Wibowo, A. & Giessen, L. Absolute and relative power gains among state agencies in forest-related land use politics. *Land Use Policy* **49**, 131-141 (2015).

31 Clarke, J. N. & McCool, D. *Staking Out the Terrain: Power and Performance Among Natural Resource Agencies*. (SUNY Press, 1996).
32 IUCN. The IUCN World Heritage Outlook (IUCN, Gland, Swizerland) (2017).
33 Badman, T. *et al.* World Heritage in Danger: A compendium of key decisions on the conservation of natural World Heritage properties via the List of World Heritage in Danger. (IUCN, Switzerland, 2009).
34 Commonwealth of Australia. Great Barrier Reef 2050 Partnership Program. (Commonwealth of Australia, Canberra, 2019).
35 Australian National Audit Office (ANAO). Award of a $443.3 Million Grant to the Great Barrier Reef Foundation. (ANAO, Canberra, 2019).
36 UNESCO World Heritage Committee. WHC/17/41.COM/7 Item 7 of the Provisional Agenda: State of conservation of World Heritage properties. (UNESCO, Poland, 2017).
37 Morrison, T. H. *et al.* Advancing coral reef governance into the Anthropocene. *One Earth* **2**, 64-74, doi:https://doi.org/10.1016/j.oneear.2019.12.014 (2020).
38 Scott, J. C. *Domination and the arts of resistance: Hidden transcripts*. (Yale University Press, 1990).
39 DeFries, R. & Nagendra, H. Ecosystem management as a wicked problem. *Science* **356**, 265-270, doi:10.1126/science.aal1950 (2017).
40 World Bank (2018) GDP per capita, PPP (current international $).
41 World Bank (2018) Worldwide Governance Indicators (www.govindicators.org).
42 Simoes, A. & Hidalgo, C. A. *The observatory of economic complexity*. (2019).
43 World Bank. International tourism, receipts (% of total exports). (2018).
44 World Bank. Exports of goods and services (current US$). (2018).
45 World Bank. Merchandise exports (current US$). (2018).
46 World Bank. Agricultural raw materials exports (% of merchandise exports). (2018).
47 World Bank. Fuel exports (% of merchandise exports). (2018).
48 World Bank. Ores and metals exports (% of merchandise exports). (2018).
49 Simoes, A. J. G. & Hidalgo, C. A. in *AAAIWS'11-17 Proceedings of the 17th AAAI Conference on Scalable Integration of Analytics and Visualization* 39-42 (2011).
50 International Monetary Fund. World economic outlook: Gaining momentum? , (International Monetary Fund, Washington, 2017).
51 Hartmann, D., Guevara, M. R., Jara-Figueroa, C., Aristaran, M. & Hidalgo, C. A. Linking economic complexity, institutions, and income inequality. *World Dev* **93**, 75-93, doi:10.1016/j.worlddev.2016.12.020 (2017).
52 Hertel-Fernandez, A., Mildenberger, M. & Stokes, L. C. Legislative staff and representation in Congress. *Am Polit Sci Rev* **113**, 1-18, doi:10.1017/S0003055418000606 (2019).
53 Hardy, C. & Maguire, S. Organizing risk: Discourse, power, and "riskification". *Academy of Management Review* **41**, 80 - 108 doi:10.5465/amr.2013.0106 (2016).
54 World Wide Fund. *PADDDtracker: Tracking Protected Area Downgrading, Downsizing, and Degazettement*. (2019).
55 Abbott, K. W., Genschel, P., Snidal, D. & Zangl, B. Two logics of indirect governance: Delegation and orchestration. *Brit J Polit Sci* **46**, 719-729, doi:10.1017/S0007123414000593 (2016).
56 Kruck, A. & Zangl, B. Trading privileges for support: the strategic co-optation of emerging powers into international institutions. *International Theory* **11**, 318-343, doi:10.1017/S1752971919000101 (2019).
57 Hameiri, S., Hughes, C. & Scarpello, F. *International intervention and local politics: Fragmented states and the politics of scale*. (Cambridge University Press, 2017).

Correspondence

All correspondence and requests for materials should be addressed to the corresponding author at tiffany.morrison@jcu.edu.au.

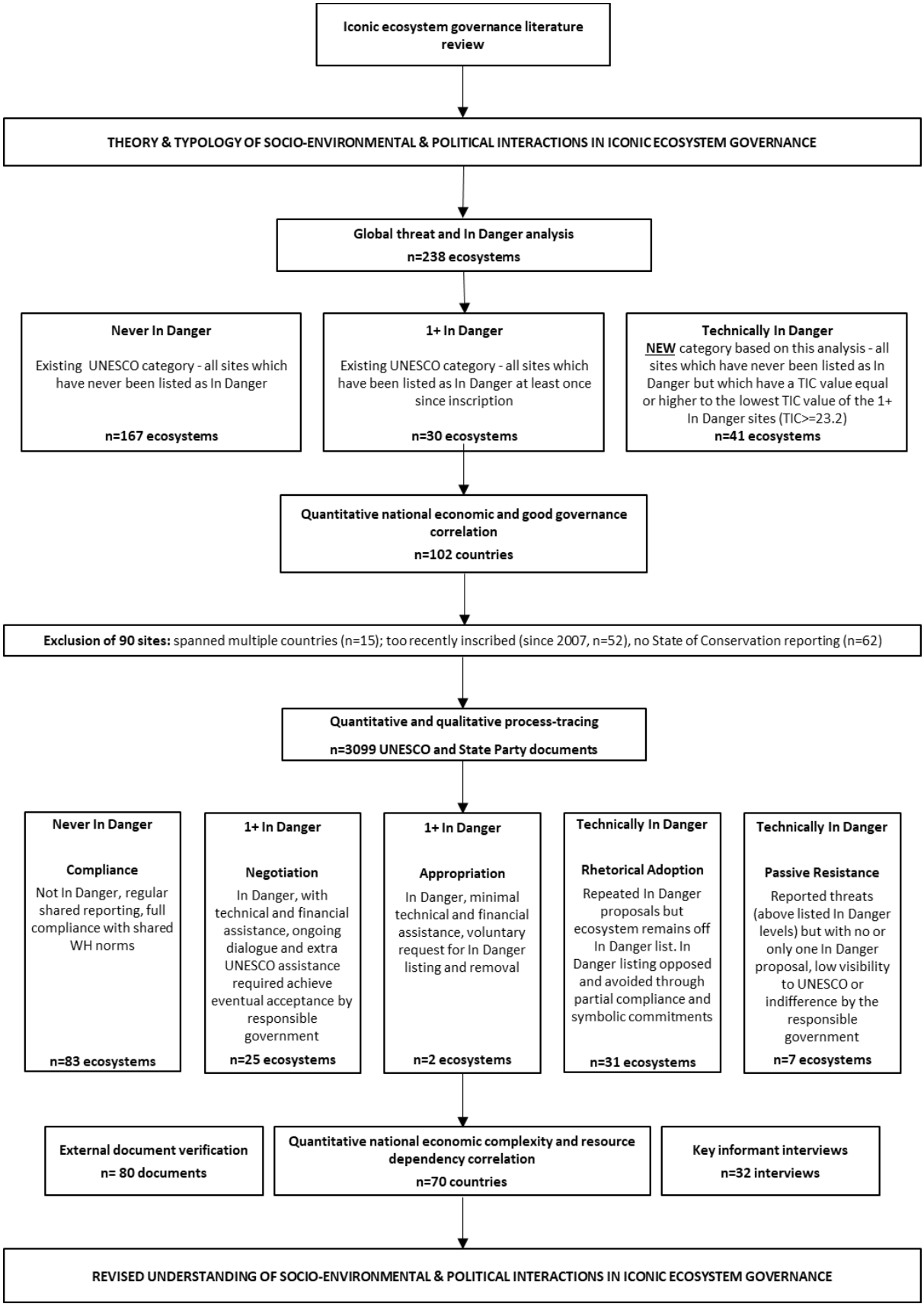
Acknowledgments

This project received ethics approval from James Cook University (no. H6149) and was supported by the Australian Research Council. The authors thank Graeme Cumming, Lucy McHugh, Pip Cohen, Jon Day, and Sarah Lawless for their helpful comments and suggestions; and project interviewees and key informants for their insightful interview responses.

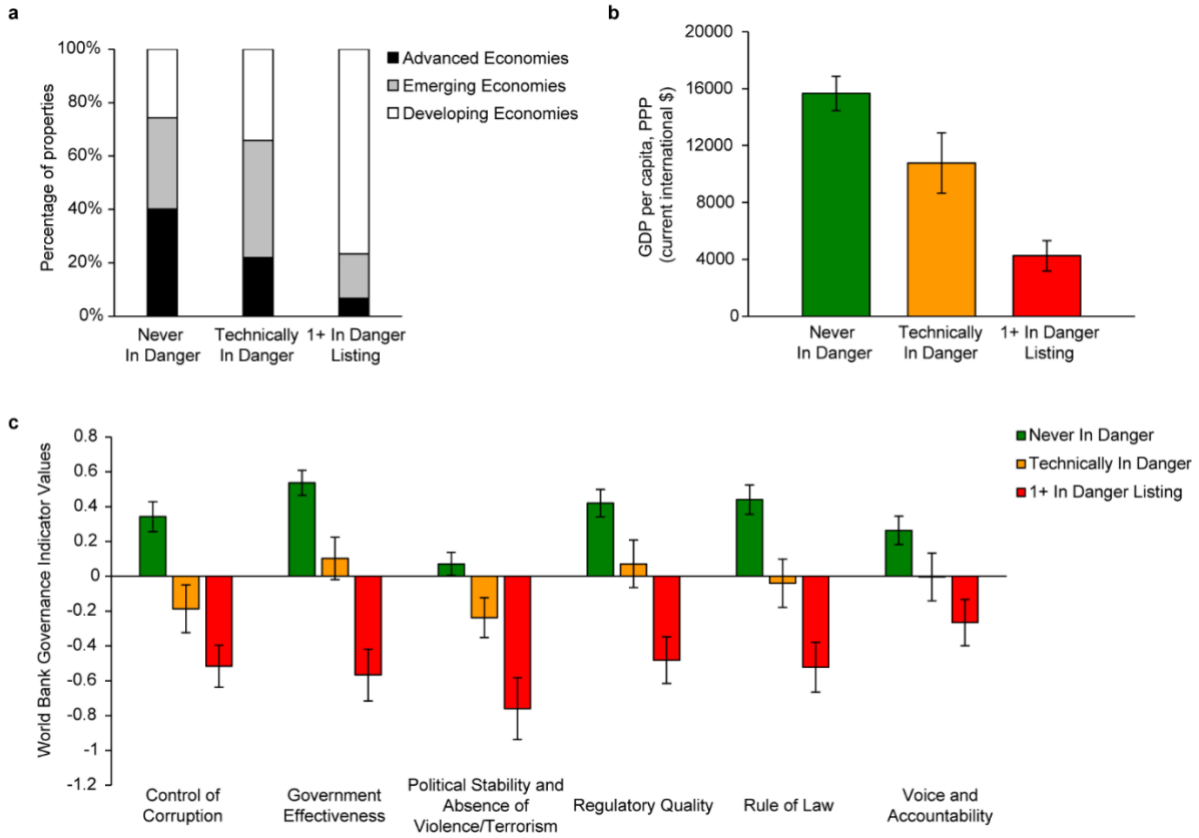
Contributions

T.H.M. conceived the idea and lead the study design. W.N.A., K.B., M.C.L. and T.P.H. contributed analytic concepts and ideas. T.H.M., M.H, and C.H. collected, collated and analysed the qualitative and quantitative data. All authors drafted, reviewed and edited the paper.

Supplementary information



Supplementary Fig. S1. Analytic process.



Supplementary Fig. S2. Economic and governance settings for Never in Danger, Technically In Danger and In Danger sites. (**a.** IMF categories of country development; **b**. WorldBank GDP per capita ppp (in current international $); **c.** Six WorldBank governance indicators).

Year	Type and Example of National Response to UNESCO Intervention
	Compliance: Ilulissat Icefjord, Denmark
2004	Inscription on World Heritage (WH) list, World Heritage Committee (WHC) requests review of ecosystem protection and management.
2007	State of Conservation (SOC) Report -WHC commends Danish government for reviewing ecosystem protection and developing revised management and monitoring plan.
2009	SOC Report -WHC notes improved legal protection.
2013	Periodic Report submitted – Outstanding Universal Value (OUV) being impacted by increased tourism and climate change but effective management in place.
2014	Retrospective statement of OUV adopted.
2018	Management Plan 2018 – 2020 released.
	Negotiation: Galápagos Islands, Ecuador
1978	Inscription on WH list.
1979	Technical and Financial Assistance, WHC commits USD $62,000 for training and equipment.
1982	Financial Assistance, WHC commits USD $10,000 for training.
1985	SOC Report and Financial Assistance, WHC commits USD $19,000 for equipment and training.
1986	SOC Report and Financial Assistance, WHC commits USD $20,000 for environmental education program.
1987	Financial Assistance, WHC commits USD $19,500 for technical advice and planning.
1988	Financial Assistance, WHC commits USD $58,250 for training and equipment.
1989	Financial Assistance, WHC commits USD $83,500 for training, equipment and planning.
1990	SOC Report and Financial Assistance, WHC commits USD $16,000 for training and tourism study.
1992	SOC Report and Financial Assistance, WHC commits USD $67,100 for training and revision of management plan.
1994	SOC Report and Financial Assistance, WHC commits USD $50,000 for equipment.
1995	SOC Report noting multiple threats: Financial resources; Fishing/collecting aquatic resources; Impacts of tourism / visitor / recreation; Invasive / alien marine species; Invasive/alien terrestrial species; Legal framework; and Management systems/ management plan.
1996	SOC Report and Mission Report - WHC proposes to list Galapagos as In Danger, which is opposed by Ecuadorian government.
1997	SOC Report - WHC decide not to inscribe on In Danger List.
1998	SOC Report and Financial Assistance, WHC commits USD $112,500 in assistance for ecological monitoring.
2000	SOC Report notes similar multiple threats to 1995, however notes that the need for a special law has now been resolved.
2001	SOC Report and Financial Assistance, WHC commits USD $50,000 in emergency assistance.
2002	SOC Report notes similar multiple threats to 2000, however notes the additional threat of illegal activities.
2003	SOC Report and Mission Report.
2004	SOC Report noting multiple continued and new threats: Financial resources; Fishing/collecting aquatic resources; Impacts of tourism / visitor / recreation; Invasive/alien terrestrial species; Legal framework; Weaknesses in quarantine measures; and Passage of international and national marine traffic.
2005	SOC Report noting multiple continued and new threats: Illegal activities; Legal framework; Management activities; and Implementation of quarantine measures
2006	SOC Report and Mission Report. SOC report noting multiple continued and new threats: Governance; Human resources; Identity, social cohesion, changes in local population and community; Illegal activities; Invasive/alien terrestrial species; Management activities; and Management systems/ management plan. Ecuadorian government opposes proposal to In Danger List.
2007	SOC Report and Mission Report. SOC report noting multiple continued and new threats: Governance; Human resources; Identity, social cohesion, changes in local population and community; Illegal activities; Impacts of tourism / visitor / recreation; Management activities; and Educational reform not implemented. Despite previous opposition by Ecuadorian government, all parties agree that Galapagos is added to In Danger List.
2008	SOC Report noting multiple continued and new threats: Governance; Human resources; Identity, social cohesion, changes in local population and community; Illegal activities; Impacts of tourism / visitor / recreation; Major visitor accommodation and associated infrastructure; Management activities; Management systems/ management plan; and Educational reform not implemented.
2009	SOC Report notes the same threats as 2008.
2010	SOC Report and Mission Report. SOC report noting multiple continued and new threats: Fishing/collecting aquatic resources; Governance; Identity, social cohesion, changes in local population and community; Illegal activities; Impacts of tourism / visitor / recreation; Major visitor accommodation and associated infrastructure; Management systems/ management plan; and Educational reform not implemented. Despite advisory board recommendation to keep Galapagos on In Danger List, WHC agrees with Ecuadorian government request to remove Galapagos from In Danger List.
2011	SOC Report noting multiple continued and new threats: Governance; Identity, social cohesion, changes in local population and community; Illegal activities; Impacts of tourism / visitor / recreation; Legal framework; Major visitor accommodation and associated infrastructure; Management systems/ management plan; and Educational reform not implemented.
2012	SOC Report noting multiple continued and new threats: Identity, social cohesion, changes in local population and community; Illegal activities; Impacts of tourism / visitor / recreation; Major visitor accommodation and associated infrastructure; Management activities; and Management systems/ management plan.
2014	SOC Report notes the same threats as 2012.
2016	SOC Report noting multiple continued and new threats: Fishing/collecting aquatic resources; Governance; Identity, social cohesion, changes in local population and community; Illegal activities; Impacts of tourism / visitor / recreation; Invasive/alien terrestrial species; Legal framework; and Major visitor accommodation and associated infrastructure.
2017	SOC Report and Mission Report, WHC notes that promises related to remove Galapagos from In Danger List have not yet been met.

2018 SOC Report notes the same threats as in 2016 (including 'governance' as a threat) and reiterates the 2017 Mission Report statement that some promises related to remove Galapagos from In Danger List in 2010 have not yet been met.
2019 WHC commits US$ 59,975 towards usage control and monitoring for the conservation and management of pelagic ecosystems.

Appropriation: Everglades National Park, USA

1979 Inscription on WH list.
1989 SOC Report noting multiple threats: Crop production; Housing; and Industrial areas.
1992 SOC Report noting the same threats as in 1989 with the addition of storms.
1993 SOC Report, WHC and US Government (under Clinton administration) agree that adding the Everglades to the In Danger List would assist in dealing with the number of agencies at various levels of government and bring an international and global dimension to the conservation of the Everglades.
1994 SOC Report noting the same threats as in 1992 with the addition of Surface water pollution and Water infrastructure.
1995 SOC Report noting the same threats as in 1994.
1996 SOC Report noting the same threats again.
1997 SOC Report noting the same threats again.
1998 SOC Report noting the same threats again.
1999 SOC Report and Mission Report.
2000 SOC Report noting the same threats again.
2001 SOC Report noting the same threats again.
2002 SOC Report noting the same threats again, excepting Storms and with the addition of Management systems/ management plan.
2003 SOC Report noting the same threats as in 2002.
2004 SOC Report noting multiple continued and new threats: Ground water pollution; Housing; Management activities; Surface water pollution; Water infrastructure; and Concerns about numbers of boaters in Florida Bay and their impacts on bottomland wilderness, including propeller scars from boat groundings.
2005 SOC Report notes same threats to 2004, excepting Management activities and Concerns about numbers of boaters and their impacts.
2006 SOC Report notes same threats to 2005, with the additional re-inclusion of Storms and Management activities.
2007 SOC Report, despite advisory board recommendation to keep Everglades on List, WHC agrees with last minute US request to remove from In Danger List (under Bush administration). Decision criticised by other stakeholders for lack of consultation.
2008 SOC Report notes same threats to 2006, but with removal of Management activities and the addition of Mercury contamination of fish and wildlife.
2009 Environmental advocacy groups mobilise petition to WHC proposing to relist Everglades as "In Danger" at June WHC meeting in Seville, Spain.
2010 SOC Report, US report to the WHC on the state of conservation of the Florida Everglades requests re-inscription on the List of World Heritage in Danger (WHC-SOC-492) (under Obama administration).
2011 SOC Report noting multiple continued and new threats: Ground water pollution; Land conversion; Management activities; Pollution of marine waters; Storms; Surface water pollution; and Mercury contamination of fish and wildlife.
2012 SOC Report notes same threats to 2011, but with removal of Land conversion and Pollution of marine waters and the addition of Housing and Water infrastructure.
2013 SOC Report and Periodic Reporting
2014 SOC Report notes same threats to 2012, but with addition of Invasive / alien freshwater species.
2015 SOC Report notes same threats as 2014.
2016 SOC Report notes same threats as 2015.
2017 SOC Report notes same threats as 2016 but with removal of Groundwater pollution.
2018 SOC Report notes same threats as 2017.
2019 SOC Report notes same threats as 2018. Site remains on In Danger List.

Rhetorical adoption - Great Barrier Reef, Australia

1981 Inscription on WH list.
1985 SOC Report, noting ground transport infrastructure as a threat.
1986 SOC Report, WHC identifies GBR as of concern.
1994 SOC Report, noting multiple threats: ground transport infrastructure, major visitor accommodation and associated infrastructure and mining.
1997 SOC Report, WHC notes that ENGOs have requested that the WHC consider inclusion on In Danger List. Process and reasons for inclusion opposed by Australian Government.
1998 SOC Report, noting same threats as 1994.
1999 SOC Report, noting same threats as 1994 with the addition of management systems/ management plan.
2000 SOC Report, noting same threats as 1999 with the addition of "need for more effective catchment management in lands adjacent to the Park".
2001 SOC Report, noting multiple continued threats: ground transport infrastructure, major visitor accommodation and associated infrastructure, management systems/ management plan, and mining.
2003 Periodic Reporting.
2004 SOC Report, noting continuing (major visitor accommodation and associated infrastructure) and new threats (commercial development, housing, marine transport infrastructure)
2005 ENGOs petition WHC seeking to have the Great Barrier Reef (Australia) and other climate-affected sites considered for List of World Heritage in Danger.
2011 SOC Report, noting multiple continuing and new threats: changes to oceanic waters, ground water pollution, marine transport infrastructure, non-renewable energy facilities, other climate change impacts, storms, surface water pollution, and temperature change.
2012 SOC Report and Mission Report, WHC considers the possible inscription of the GBR on the List of World Heritage in Danger in the absence of substantial progress on controlling proposed coastal development.

2013	SOC Report, WHC reiterates 2012 decision to consider the possible inscription of the GBR on the List of World Heritage in Danger.
2014	SOC Report, WHC reiterates 2013 decision to consider the possible inscription of the GBR on the List of World Heritage in Danger. Australian government disputes.
2015	SOC Report, Australian government avoids potential In Danger Listing by agreeing to develop a long-term sustainability plan.
2017	SOC Report, noting the same threats as 2011, with the addition of "grounding of ships".
2019	Australian national audit and Senate inquiry finds significant portion of finance for long-term GBR Plan deliberately delivered in a non-compliant process to a low capacity private organization, thereby jeopardizing ability to achieve key actions and outcomes of plan. Australian government also lobbies WHC to prevent climate impacts being used as the basis for an In Danger listing. Site remains off In Danger List (despite multiple proposals for In Danger listing, clear rising threats, and a Threat Intensity value equal or higher to the lowest Threat Intensity value of the In danger sites.)

	Passive Resistance - Ha Long Bay, Vietnam
1994	Inscription on WH list.
1995	SOC Report notes major visitor accommodation and associated infrastructure and marine transport infrastructure as threats.
1996	SOC Report and Financial Assistance. Concerns over proposed port development and large floating hotel. WHC commits USD $24,250 towards sustainable tourism management planning and staff training.
1997	SOC Report and Financial Assistance. Concerns over enforcement of environmental regulation along the coastal zone. WHC commits USD $20,000 towards purchase of management equipment.
1998	SOC Report, Mission Report and Financial Assistance. WHC commits USD $8,857 for geomorphology study as part of the Environmental Impact Assessment underway for proposed port and bridge development. World Bank oversees Mission Report on options for comprehensive development of area, including augmented lending in accordance with the Bank's Country Assistance Strategy. World Bank (Vietnamese Office) takes over co-ordination of development and conservation activities in World Heritage Area.
1999	SOC Report notes continuing (marine transport infrastructure) and new threats (impacts of tourism / visitor / recreation).
2000	SOC Report, Mission Report and Financial Assistance. Concerns over capacity to manage cumulative impacts of multiple development projects. WHC commits USD $14,508 for management capacity strengthening workshop. IUCN Mission Report notes improved management but significant challenges remain including over-fishing, solid and organic waste, and need for effective regional planning.
2001	SOC Report notes continued and new threats: ground transport infrastructure; impacts of tourism / visitor / recreation; management systems/ management plan; marine transport infrastructure; and rapid economic development.
2002	SOC Report notes same threats as 2001.
2003	SOC Report and Periodic Report.
2004	SOC Report notes continued and new threats: financial resources; housing; human resources; identity, social cohesion, changes in local population and community; illegal activities; impacts of tourism / visitor / recreation; management systems/ management plan; mining; and oil and gas.
2006	SOC Report notes continued and new threats: financial resources; housing; human resources; identity, social cohesion, changes in local population and community; impacts of tourism / visitor / recreation; industrial areas; major visitor accommodation and associated infrastructure; and management systems/ management plan.
2007	SOC Report and Financial Assistance. Concerns over growing urban, industrial and tourism development pressures and lack of an integrated planning approach. WHC commits USD 65780 towards institutional strengthening project plus USD619000 extra-budgetary funds for cultural preservation.
2009	SOC Report notes same threats as 2006, excluding "impacts of tourism / visitor / recreation".
2011	SOC Report notes continued threats: financial resources; housing; identity, social cohesion, changes in local population and community; impacts of tourism / visitor / recreation; industrial areas; major visitor accommodation and associated infrastructure; and management systems/ management plan.
2013	SOC Report, IUCN Reactive Monitoring Mission Report recommends that Vietnam government strengthen administrative capability of management authority by allowing it a greater degree of independence, authority, and decision-making power in conducting its day-to-day management and enforcement roles and responsibilities.
2014	SOC Report, WHC commends progress but reiterates IUCN recommendation above and encourages State Party to increase contribution of tourism revenue to management authority, with progress report due 2016
2018	Financial Assistance. WHC commits USD $29,750 for management effectiveness evaluation.
2019	Site remains off In Danger list (and has never even been proposed for In Danger listing) despite clear rising threats and a Threat Intensity value equal or higher to the lowest Threat Intensity value of the In danger sites.

Supplementary Table S1. Process-tracing of different types of national responses to UNESCO intervention in WH ecosystems, with representative examples.

Type of Response	Site Name (Country)
Compliance *(Never in Danger regular shared reporting, full compliance with shared WH norms)*	Aldabra Atoll (Seychelles) Alejandro de Humboldt National Park (Cuba) Ancient Maya City and Protected Tropical Forests of Calakmul, Campeche (Mexico) Area de Conservación Guanacaste (Costa Rica) Australian Fossil Mammal Sites (Riversleigh / Naracoorte) (Australia) Bwindi Impenetrable National Park (Uganda) Canadian Rocky Mountain Parks (Canada) Canaima National Park (Venezuela (Bolivarian Republic of)) Cape Floral Region Protected Areas (South Africa) Cerrado Protected Areas: Chapada dos Veadeiros and Emas National Parks (Brazil) Cliff of Bandiagara (Land of the Dogons) (Mali) Cocos Island National Park (Costa Rica) Dinosaur Provincial Park (Canada) Dorset and East Devon Coast (United Kingdom of Great Britain and Northern Ireland) Fraser Island (Australia) Garajonay National Park (Spain) Giant's Causeway and Causeway Coast (United Kingdom of Great Britain and Northern Ireland) Gondwana Rainforests of Australia (Australia) Göreme National Park and the Rock Sites of Cappadocia (Turkey) Gough and Inaccessible Islands (United Kingdom of Great Britain and Northern Ireland) Grand Canyon National Park (United States of America) Great Smoky Mountains National Park (United States of America) Greater Blue Mountains Area (Australia) Gros Morne National Park (Canada) Gulf of Porto: Calanche of Piana, Gulf of Girolata, Scandola Reserve (France) Gunung Mulu National Park (Malaysia) Hawaii Volcanoes National Park (United States of America) Heard and McDonald Islands (Australia) Hierapolis-Pamukkale (Turkey) Huanglong Scenic and Historic Interest Area (China) Huascarán National Park (Peru) Ibiza, Biodiversity and Culture (Spain) Ilulissat Icefjord (Denmark) iSimangaliso Wetland Park (South Africa) Islands and Protected Areas of the Gulf of California (Mexico) Jiuzhaigou Valley Scenic and Historic Interest Area (China) Kaziranga National Park (India) Lake Malawi National Park (Malawi) Lake Turkana National Parks (Kenya) Laurisilva of Madeira (Portugal) Los Glaciares National Park (Argentina) Macquarie Island (Australia) Mammoth Cave National Park (United States of America) Mana Pools National Park, Sapi and Chewore Safari Areas (Zimbabwe) Manú National Park (Peru) Miguasha National Park (Canada) Morne Trois Pitons National Park (Dominica) Mount Emei Scenic Area, including Leshan Giant Buddha Scenic Area (China) Mount Huangshan (China) Mount Taishan (China) Nahanni National Park (Canada) Nanda Devi and Valley of Flowers National Parks (India) Natural and Cultural Heritage of the Ohrid region (the Former Yugoslav Republic of Macedonia) Natural System of Wrangel Island Reserve (Russian Federation)

	Noel Kempff Mercado National Park (Bolivia (Plurinational State of))
	Olympic National Park (United States of America)
	Phong Nha – Ke Bang National Park (Viet Nam)
	Puerto-Princesa Subterranean River National Park (Philippines)
	Purnululu National Park (Australia)
	Redwood National and State Parks (United States of America)
	Río Abiseo National Park (Peru)
	Shark Bay, Western Australia (Australia)
	Shirakami-Sanchi (Japan)
	Shiretoko (Japan)
	Sian Ka'an (Mexico)
	Sichuan Giant Panda Sanctuaries - Wolong, Mt Siguniang and Jiajin Mountains (China)
	Sinharaja Forest Reserve (Sri Lanka)
	Škocjan Caves (Slovenia)
	St Kilda (United Kingdom of Great Britain and Northern Ireland)
	Sundarbans National Park (India)
	Te Wahipounamu – South West New Zealand (New Zealand)
	Thungyai-Huai Kha Khaeng Wildlife Sanctuaries (Thailand)
	Tikal National Park (Guatemala)
	Tongariro National Park (New Zealand)
	Tsingy de Bemaraha Strict Nature Reserve (Madagascar)
	Uluru-Kata Tjuta National Park (Australia)
	Vredefort Dome (South Africa)
	W National Park of Niger (Niger)
	Wadi Al-Hitan (Whale Valley) (Egypt)
	Wet Tropics of Queensland (Australia)
	Willandra Lakes Region (Australia)
	Wulingyuan Scenic and Historic Interest Area (China)
	Yakushima (Japan)
Negotiation *(In Danger, technical and financial assistance, ongoing dialogue and extra UNESCO assistance required to achieve eventual acceptance by responsible government)*	Air and Ténéré Natural Reserves (Niger)
	Belize Barrier Reef Reserve System (Belize)
	Comoé National Park (Côte d'Ivoire)
	Djoudj National Bird Sanctuary (Senegal)
	East Rennell (Solomon Islands)
	Galápagos Islands (Ecuador)
	Garamba National Park (Democratic Republic of the Congo)
	Ichkeul National Park (Tunisia)
	Kahuzi-Biega National Park (Democratic Republic of the Congo)
	Los Katíos National Park (Colombia)
	Manas Wildlife Sanctuary (India)
	Manovo-Gounda St Floris National Park (Central African Republic)
	Ngorongoro Conservation Area (United Republic of Tanzania)
	Niokolo-Koba National Park (Senegal)
	Okapi Wildlife Reserve (Democratic Republic of the Congo)
	Plitvice Lakes National Park (Croatia)
	Río Plátano Biosphere Reserve (Honduras)
	Rwenzori Mountains National Park (Uganda)
	Salonga National Park (Democratic Republic of the Congo)
	Sangay National Park (Ecuador)
	Selous Game Reserve (United Republic of Tanzania)
	Simien National Park (Ethiopia)
	Srebarna Nature Reserve (Bulgaria)
	Tropical Rainforest Heritage of Sumatra (Indonesia)
	Virunga National Park (Democratic Republic of the Congo)

Appropriation *(In Danger, minimal technical and financial assistance, voluntary request for In Danger listing and removal)*	Everglades National Park (United States of America) Yellowstone National Park (United States of America)
Rhetorical Adoption *(Technically in Danger, repeated In Danger proposals but site remains off In Danger list, In Danger listing opposed and avoided through partial compliance and symbolic commitments)*	Chitwan National Park (Nepal) Coiba National Park and its Special Zone of Marine Protection (Panama) Dja Faunal Reserve (Cameroon) Doñana National Park (Spain) Dong Phayayen-Khao Yai Forest Complex (Thailand) Durmitor National Park (Montenegro) Golden Mountains of Altai (Russian Federation) Great Barrier Reef (Australia) Historic Sanctuary of Machu Picchu (Peru) Isole Eolie (Aeolian Islands) (Italy) Kakadu National Park (Australia) Keoladeo National Park (India) Lake Baikal (Russian Federation) Lorentz National Park (Indonesia) Mount Kenya National Park/Natural Forest (Kenya) Pirin National Park (Bulgaria) Pitons Management Area (Saint Lucia) Sagarmatha National Park (Nepal) Serengeti National Park (United Republic of Tanzania) Taï National Park (Côte d'Ivoire) Tasmanian Wilderness (Australia) The Sundarbans (Bangladesh) Three Parallel Rivers of Yunnan Protected Areas (China) Virgin Komi Forests (Russian Federation) Volcanoes of Kamchatka (Russian Federation) Western Caucasus (Russian Federation) Whale Sanctuary of El Vizcaino (Mexico) Wood Buffalo National Park (Canada)
Passive Resistance *(Technically in Danger, reported threats (above certified In Danger levels) but with no or only one In Danger proposal, low visibility to UNESCO or indifference by the responsible government)*	Banc d'Arguin National Park (Mauritania) Danube Delta (Romania) Ha Long Bay (Viet Nam) Henderson Island (United Kingdom of Great Britain and Northern Ireland) Komodo National Park (Indonesia) Mount Athos (Greece) Tubbataha Reefs Natural Park (Philippines)

Supplementary Table S2. Catalogue of sites according to type of national response.

Supplementary SI References

1. UNESCO (2019) UNESCO World Heritage. (UNESCO World Heritage Centre, Paris, France).
2. Patry M, Bassettand C, & Leclerq B (2005) The state of conservation of world heritage forests. *Proceedings of the 2nd World Heritage Forest Meeting* March 11-13.
3. International Monetary Fund (2017) World economic outlook: Gaining momentum? (International Monetary Fund, Washington).
4. World Bank (2018) GDP per capita, PPP (current international $).
5. World Bank (2018) Worldwide Governance Indicators (www.govindicators.org).
6. World Bank (2018) International tourism, receipts (% of total exports).
7. World Bank (2018) Exports of goods and services (current US$).
8. World Bank (2018) Merchandise exports (current US$).
9. World Bank (2018) Agricultural raw materials exports (% of merchandise exports).
10. World Bank (2018) Fuel exports (% of merchandise exports).
11. World Bank (2018) Ores and metals exports (% of merchandise exports).
12. Simoes AJG & Hidalgo CA (2011) The economic complexity observatory: An analytical tool for understanding the dynamics of economic development. *Proceedings of the 17th AAAI Conference on Scalable Integration of Analytics and Visualization*, California)
13. IUCN (2017) The IUCN World Heritage Outlook. (IUCN, Gland, Switzerland).
14. Osipova E, *et al.* (2017) IUCN World Heritage Outlook 2: A conservation assessment of all natural World Heritage sites. (IUCN, Gland, Switzerland).
15. Cameron C & Rössler M (2016) Many voices, one vision: The early years of the World Heritage Convention (Routledge, London).
16. Badman T, et al. (2009) World Heritage in Danger: A compendium of key decisions on the conservation of natural World Heritage properties via the List of World Heritage in Danger. (IUCN, Gland, Switzerland).
17. de Wit W, Machimbarrena M, Tench E, & Bigaud N (2019) Our Natural World at Risk: How politicization is limiting the effectiveness of the World Heritage Convention. (Dalberg Advisors for World Wide Fund for Nature, Gland, Switzerland).
18. Commonwealth of Australia (2019) Great Barrier Reef 2050 Partnership Program. in Environment and Communications References Committee (Commonwealth of Australia, Canberra).
19. Australian National Audit Office (ANAO) (2019) Award of a $443.3 million grant to the Great Barrier Reef Foundation. (ANAO, Canberra).
20. UNESCO World Heritage Committee (2017) WHC/17/41.COM/7 Item 7 of the Provisional Agenda: State of conservation of World Heritage properties. (UNESCO World Heritage Committee, Krakow, Poland).